REMARKS

Claims 1 - 25 remain active in this application. Claims 1, 4, 5, 9 and 25 have been amended; claims 4 and 25 including reformatting for improved clarity. Support for the amendments of the claims is found throughout the application, particularly in Figure 2 and the description of the invention on pages 6 - 8. No new matter has been introduced into the application.

The Examiner has objected to claim 4; asserting that the phrase "computer resources and resources" is inclusive and requiring appropriate amendment. This objection and requirement is respectfully traversed as being moot in view of the amendments made above.

While the basis for the Examiner's objection is not entirely understood, it is clear that the Examiner has misunderstood the context and syntax of the claim language. Specifically, the second recitation of "resources" is the initial word of a second ("wherein") recitation of the claim. Accordingly, claim 4 has been clarified by the addition of a comma to separate the two recitations and the claim has also been reformatted as presented above to further emphasize the grammatical construction of the claim. Also, since similar language has been used in claim 25, a similar amendment has been made therein. If any other issue is seen to remain, it is respectfully requested that the Examiner contact the undersigned by telephone at the number provided below in order to expeditiously resolve the same.

The Examiner has also objected to claim 12 due to the recitation of "Hessian $\nabla^2 f$" which the Examiner has asserted "is not addressed sufficiently in the specification such that one skilled in the art can implement the invention. This objection is respectfully

traversed since the terminology "Hessian" is well-known and well-recognized in mathematics and mathematical programming in particular. A website describing "Hessian" is available and a copy (containing the website address) is attached for the Examiner's convenience. Therefore, since one skilled in the art would be familiar with the term, it is respectfully submitted that there is no substantive basis for this objection and reconsideration and withdrawal thereof is respectfully requested.

Claims 1 - 25 have been rejected under 35 U.S.C. §102 as being anticipated by the publication Introduction to Neural Networks, published by California Scientific Software and identified by the Examiner as "CSS". This sole ground of rejection is respectfully traversed.

The invention is directed to a method and apparatus for deriving a value of a vector which corresponds to a substantial optimization of $f(x)$ where f is unknown (making evaluation impossible) or unduly burdensome to evaluate. See, for example, page 6, lines 20 - 23 and note, particularly, page 5, lines 20 - 24 in regard to the preferred application of the invention. This is achieved through an optimization algorithm (a repeated, iterative search computation) using a gradient of $f(x)$ (e.g. *marginal* utility or cost, defined at page 6, lines 4 - 5, as the increment in utility obtained from an incremental increase of a resource), which may be approximated, and possibly the Hessian of $f(x)$, if available. (As discussed above, the Hessian is generally known in mathematical programming and, if available, as least by approximation, it is also generally known that the ability to evaluate the Hessian generally improves the performance of the optimization algorithm in terms of requiring fewer iterations and obtaining better results.

In particular, when the Hessian is not available, one generally resorts to approximating the Hessian using quasi-Newton techniques.) In general, the iterative search computation includes a line search component where, beginning with an initial step size, the step size is decreased as necessary. The iterative optimization search algorithm is then run until an end condition is satisfied in which the marginal utility satisfies the Karush-Kuhn-Tucker conditions without a particular degree of accuracy being required. Satisfaction of such conditions indicates that no significant further improvement in optimizing the utility is available. However, unlike known search techniques, the end condition in accordance with the invention does not require evaluation of $f(x)$, as discussed on page 7. Thus, the invention provides for substantial optimization of $f(x)$ without requiring evaluation of $f(x)$ or even knowledge of f.

In sharp contrast with the invention as claimed, neural network technology, particularly as described in CSS, provides for the development of an objective function that may be "learned" or constructed (e.g. over time) and which, at any given point in time or the learning operation, is embodied by the weights and states of the neural network. Therefore, even if the construction of the objective function is incomplete, the objective function is always known to the extent it has, to that point, been constructed. Further, obtaining a response to a given set of stimuli (which may or may not have been explicitly "learned") from a neural network requires an evaluation of the objective function as it exists at the time the stimuli are applied, even though the selected pages of CSS provided by the Examiner do not clearly indicate if an objective function is evaluated or

not. For this principal reason, it is clearly seen that the analogies the Examiner seeks to draw between the "concept" of the invention and a neural network is deeply flawed and, in any event, drawing analogy of aspects of a reference to the "concept" of the invention is not at all probative of the issue of anticipation of the subject matter actually claimed.

Specifically, while the relation of "margin" to the change of "output" to a change of "input" may be arguable, it does not respond to, much less answer, the recitation of a "marginal *utility*" or "gradient" (as distinct from "utility" as now recited) which is, in fact, known or can be approximated and which is evaluated in order to achieve substantial optimization of a function or relationship which is *not* evaluated. Further, "reducing the step size, *if necessary*" (independent claims 1 and 5, emphasis added, especially "based on said marginal utility", as now recited) or "applying the calculated constraint function information and marginal utility information to obtain a next allocation" (independent claim 9) are operations specific to an optimization search (e.g. to determine if a particular step size is within the constraints) and are not at all related to a learning rate under Hebbs' Rule, as the Examiner asserts. (It should be noted in this regard that while CSS mentions a learning rate whhich the Examiner asserts is in some way comparable to the claimed step size, there is no teaching or suggestion of modifying that learning rate or step size in accordance with constraints or based on a marginal utility as now recited, or any other parameter of the process or problem.) As indicated in the pages of CSS supplied by the Examiner, a learning rate is only relevant to the behavior of the neural network during training (e.g.

learning may not be efficient or lead to instability if learning is too fast or too slow) and thus has nothing to do with "deploying an effective step size for utility *optimization*" (independent claims 1 and 5, emphasis added) where "utility" corresponds to an objective function or to "returning a locally *optimized* allocation of resources" (claim 9, emphasis added) whereas, in a neural network, the objective function is a developed or "learned" response to combinations of stimuli which is constructed through training and not subject to optimization. (While "optimization" is listed in CSS as an ability of a neural network, the exemplary application therefore is stated to be "flight scheduling" which is not a matter of *quantitative* optimization such as a *quantity* of resources to be allocated to optimize utility.) Neither does the operation of a neural network or any of the types discussed in CSS involve repetition of steps, calculation of constraint functions or determining satisfaction of stopping criteria, all as recited in independent claim 9. Moreover, it is respectfully submitted that reducing a step size, if necessary, particularly in combination with deploying a resulting step size for utility optimization, as claimed, is characteristic of an iterative search optimization algorithm which is entirely distinct from any neural network operation or function, including learning/training operations.

In summary, the Examiner has merely attempted to assert extremely tenuous and doubtful *conceptual* similarities between some elements or operations of a neural network and some individual features by which the present invention is distinguished from other *optimization* methodologies but has clearly failed to demonstrate that the invention, in all the particularity

claimed, has been disclosed in the CSS reference. MPEP §2131.05, and precedents cited therein, relied upon by the Examiner, indicates that non-analogy is irrelevant to anticipation if the invention is, in fact, *actually disclosed*, in all the particularity claimed, in the reference relied upon but certainly does not countenance mapping of the *concept* of the invention onto substantially non-analogous individual elements of a non-analogous arrangement for processing for a non-analogous purpose as the Examiner has attempted to do by asserting some speculative similarity of individual elements or steps, particularly where significant *differences* of each element or step from those of the reference are recited in the claims and which the Examiner effectively ignores.

Accordingly, it is respectfully submitted that the rejection of claims 1 - 25 as asserted by the Examiner is clearly in error and untenable on its face, particularly as being directly contrary to the very authority (MPEP §2131.05 and precedents cited therein) on which the Examiner relies. No demonstration of anticipation consistent with that authority has been made based on CSS and, it is respectfully submitted that none can be made. Anticipation requires that a disclosure of the invention, as claimed, be demonstrated and not merely assertion of some asserted similarity of *concepts* of the invention to substantially unrelated *concepts* of substantially unrelated devices or methodologies. Therefore, reconsideration and withdrawal of the rejection of claims 1 - 25 based on CSS are respectfully requested.

Since all rejections, objections and requirements contained in the outstanding official action have been fully answered and shown to be in error and/or inapplicable to the present claims, it is respectfully submitted that reconsideration is now in order under the

provisions of 37 C.F.R. §1.111(b) and such reconsideration is respectfully requested. Upon reconsideration, it is also respectfully submitted that this application is in condition for allowance and such action is therefore respectfully requested.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Deposit Account No. 50-0510 of International Business Machines corporation (Yorktown).

Respectfully submitted,

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Attachment:
Print-out of definition of "Hessian"

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Hessian

COMMENT
On this Page

The Jacobian matrix of the derivatives $\partial f/\partial x_1$, $\partial f/\partial x_2$, ..., $\partial f/\partial x_n$ of a function $f(x_1, x_2, \ldots, x_n)$ with respect to x_1, x_2, ..., x_n is called the Hessian H of f, i.e.,

$$H f(x_1, x_2, \ldots, x_n) = \begin{bmatrix} \frac{\partial^2 f}{\partial x_1^2} & \frac{\partial^2 f}{\partial x_1\,\partial x_2} & \frac{\partial^2 f}{\partial x_1\,\partial x_3} & \cdots & \frac{\partial^2 f}{\partial x_1\,\partial x_n} \\ \frac{\partial^2 f}{\partial x_2\,\partial x_1} & \frac{\partial^2 f}{\partial x_2^2} & \frac{\partial^2 f}{\partial x_2\,\partial x_3} & \cdots & \frac{\partial^2 f}{\partial x_2\,\partial x_n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \frac{\partial^2 f}{\partial x_n\,\partial x_1} & \frac{\partial^2 f}{\partial x_n\,\partial x_2} & \frac{\partial^2 f}{\partial x_n\,\partial x_3} & \cdots & \frac{\partial^2 f}{\partial x_n^2} \end{bmatrix}.$$

As in the case of the Jacobian, the term "Hessian" unfortunately appears to be used both to refer to this matrix and to the determinant of this matrix (Gradshteyn and Ryzhik 2000, p. 1069).

In the second derivative test for determining extrema of a function $f(x, y)$, the discriminant D is given by

$$H f(x, y) \equiv \begin{vmatrix} \frac{\partial^2 f}{\partial x^2} & \frac{\partial^2 f}{\partial x\,\partial y} \\ \frac{\partial^2 f}{\partial y\,\partial x} & \frac{\partial^2 f}{\partial y^2} \end{vmatrix}.$$

SEE ALSO: Jacobian, Second Derivative Test. [Pages Linking Here]

REFERENCES:

Gradshteyn, I. S. and Ryzhik, I. M. "Hessian Determinants." §14.314 in *Tables of Integrals, Series, and Products, 6th ed.* San Diego, CA: Academic Press, p. 1069, 2000.

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